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Study of the surface relief morphology of sheet metal with textured polymer coatings

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Surface roughness is manifested as defects for many types of products. However, in the last decade, there has been a need for new materials with additional design functions, for example, textured polymer sheet coatings of metal sheet. Such coatings ideally give a natural and noble appearance for the building structures (roof, etc.). The surface roughness affects the mechanical and optical properties of the materials. Their accounting is necessary for engineering calculations and industrial exploitation of materials with specific types of coatings. However, a theoretical study of these properties is possible only if the 3D relief function of the distribution of the defects under consideration is known.

Optical microscopy (OM) and scanning probe microscopy (SPM) methods have been used to analyze the surfaces of sheet metal samples with polyester textured coatings. The dependences of the type of defects (grooves), their geometrical parameters and their distribution over the surface of the polyester coating (the concentration of centers of "thickening" paint pigments) have been studied for samples of coatings obtained under different conditions of their formation: temperatures of the primer and front layer, thickness of the front layer, paint batches.

Because the character of the distribution of defects in the textured coating is complex and irregular, it was convenient to use the ideas of fractal geometry in our work. A computer simulation of the relief rough surfaces was based on fractal functions constructed by methods of random walks (diffusion limited aggregation model). New methods for constructing fractal functions in 3D space have been developed. We analyzed the type this functions in depending of their parameters. The value of the fractal dimension of the models is determined. It is shown that modeling at different scales of research requires, different algorithms in order to more detailed investigation of individual surface areas.

At comparison experimental data and fractals constructed by means of the distribution functions of the number and amplitude of defects on the surface of the coating, the method for determining the parameters of fractal functions has been developed is given. The research results will allow to develop a methodology for the convergence for rolled metal with textured polymer coatings, allowing to identify the conformity between the color and texture of sample surfaces and the standard.